UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

May 14, 2002

R.A. Larson
State Environmental Coordinator
U.S. Department of Agriculture, Rural Development
State Office
1835 Black Lake Blvd. SW
Olympia, WA 98512-5715

Re: Biological Opinion for City of Cle Elum/Town of South Cle Elum Water Systems Improvement Project (NMFS No. WSB-01-474)

Dear Mr. Larson:

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended, 16 U.S.C. 1531, *et seq*. and the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, the attached document transmits the National Marine Fisheries Service's (NMFS) Biological Opinion (BO) and MSA consultation on construction activities necessary for improvements to the City of Cle Elum and Town of South Cle Elum municipal water systems. Construction elements of the subject line project will occur in the Yakima and Cle Elum Rivers near the city of Cle Elum, in Kittitas County, Washington. The U.S. Department of Agriculture, Rural Development (USDA-RD) determined that the proposed action was likely to adversely affect the Middle Columbia River steelhead (*Oncorhynchus mykiss*) Evolutionarily Significant Unit (ESU), and requested formal consultation. NMFS concurred with this determination, and initiated formal consultation.

This BO reflects the results of a formal ESA consultation and contains an analysis of effects covering the Middle Columbia River steelhead in the Yakima and Cle Elum Rivers, Washington. The BO is based on information provided in the Biological Assessment (BA) and its subsequent addenda sent to NMFS by USDA-RD, and additional information transmitted via telephone conversations and e-mail. A complete administrative record of this consultation is on file at the Washington Habitat Branch Office.

The NMFS concludes that implementation of the proposed project is not likely to jeopardize the continued existence of Middle Columbia River steelhead or result in destruction or adverse modification of their Critical Habitat. In your review, please note that the incidental take statement, which includes Reasonable and Prudent Measures and Terms and Conditions, was designed to minimize take.

The attached BO contains an analysis of the effects of the proposed action on designated critical habitat. Shortly before the issuance of this BO, however, a Federal court vacated the rule designating critical habitat for the ESUs considered in this BO. The analysis and conclusions regarding critical habitat remain informative for our application of the jeopardy standard even though they no longer have independent legal significance. Also, if critical habitat is designated before this action is fully implemented, the analysis will be relevant when determining whether a reinitiation of consultation will be necessary at that time. For these reasons and the need to timely issue this BO, NMFS critical habitat analysis has not been removed from this BO.

The MSA consultation concluded that the proposed project may adversely impact designated Essential Fish Habitat (EFH) for chinook (*O. tshawytscha*) and coho (*O. kisutch*) salmon. The Reasonable and Prudent Measures of the ESA consultation, and Terms and Conditions identified therein, would address the negative effects resulting from the proposed USDA-RD actions. Therefore, NMFS recommends that they be adopted as EFH conservation measures.

If you have any questions, please contact Kale Gullett of the Washington Habitat Branch, Ellensburg Field Office at (509) 925-2638.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation

Biological Opinion

And

Magnuson-Stevens Fishery Conservation and Management Act

Essential Fish Habitat Consultation

City of Cle Elum/Town of South Cle Elum Water Systems Improvement Project
Kittitas County, Washington
WSB-01-474

Action Agency: U.S. Department of Agriculture, Rural Development

Consultation Conducted by: National Marine Fisheries Service, Northwest Region, Washington Habitat Branch

Issued by: for Michael R Crouse ______________________ Date Issued: May 14, 2002
D. Robert Lohn
Regional Administrator

TABLE OF CONTENTS

1.0 INTRODUCTION

This document is the product of an Endangered Species Act (ESA) Section 7 formal consultation and Magnuson-Stevens Fishery Conservation and Management Act (MSA) Essential Fish Habitat (EFH) consultation between the National Marine Fisheries Service (NMFS) and the US Department of Agriculture, Rural Development (USDA-RD) on proposed improvements to the municipal water supply system of the City of Cle Elum (CCE) and Town of South Cle Elum (TSCE), in Kittitas County, Washington. Elements of the project involve work in the Cle Elum and Yakima Rivers, located in the Middle Columbia River (MCR) steelhead (*Oncorhynchus mykiss*) Evolutionarily Significant Unit (ESU) and designated at Essential Fish Habitat (EFH) for chinook and coho salmon. This document analyzes the biological effects of construction activities related to improving the municipal water system for the CCE and TSCE.

1.1 Background Information

Since 1991, the CCE and TSCE have been under a Washington State Department of Health order to provide adequate treatment of its surface-water sources in accordance with the Federal Safe Drinking Water Act (Public Law (P.L.) 93-523), as amended (P.L. 104-182). In 1997, the two municipal entities jointly prepared a Comprehensive Water Plan (CWP) that projected future growth, described present water system facilities, identified system deficiencies, and recommended system improvements (Pentec 2000). Pursuant to recommendations in the CWP, system requirements for both CCE and the TSCE were combined into one functional system, including shared water treatment (CCE and TSCE Water Systems Improvement Project, hereafter referred to as the CCE and TSCE water project). Grant funds were obtained in 1998 from USDA-RD for a portion of the cost of the improvements identified in the CWP.

The project under consultation is a continuation of work initiated in November, 2000 and completed in January, 2001 as an emergency action to address eminent structural danger at the South Cle Elum Bridge over the Yakima River. Elements of the CCE and TSCE water project were constructed to improve bridge safety, prevent future erosion at the footings of the bridge, and minimize the potential for future in-water work while safety concerns were alleviated (*i.e.*, when in-water construction to protect the bridge was undertaken, adjacent in-water elements of the CCE and TSCE water project were installed). NMFS issued a Biological Opinion (BO) on this portion of the larger project to the US Army Corps of Engineers on November 8, 2000 (WSB-00-480). This BO and its supporting documentation are on file at NMFS Washington Habitat Branch, Lacey, Washington.

The CCE and TSCE are the proponents of the action that is the subject of this consultation. Funding for elements of this project will be provided by USDA-RD, thus creating a Federal nexus and the need for Section 7 consultation. Further description of this project is provided in Section 1.3, below.

1.2 Consultation History

The USDA-RD requested formal consultation on November 5, 2001, through submission of a Biological Assessment Addendum (BAA) with an effect determination of "may affect, likely to adversely affect" for ESA listed (Threatened) Middle Columbia River (MCR) steelhead (*Oncorhychus mykiss*). After analysis and review of the proposed action as presented, NMFS concurred with this determination and initiated formal consultation. The formal consultation process involved reviewing information contained in an original BA dated October 24, 2000, its subsequent addenda, and correspondence and communication between the Washington Department of Fisheries and Wildlife (WDFW), USDA-RD (through their consultants), and NMFS (phone calls, meetings, and electronic mail (e-mail)). NMFS reviewed the following information and engaged in the following steps to reach its determination and prepare this consultation:

1. November 5, 2001 receipt of BA Addendum #1 and letter from USDA-RD requesting formal consultation.

2. February 5, 2002 meeting in Ellensburg, Washington with USDA-RD consultants to discuss BA Addendum 1 contents and elements requiring further information.

3. March 8, 2002 receipt of BA Addendum #2 from Entrix Consultants, produced in response to issues and questions raised at February 5th meeting in Ellensburg, Washington. This document included screening design criteria.

4. March 18 and 21, 2002, receipt of e-mails from Entrix Consultants responding to questions raised during review of BA Addendum #2. These communications and completed data requirements necessary to complete formal consultation.

In addition to the key events listed above, other information was informally transferred via email, and phone calls between the WDFW, NMFS, and USDA-RD (through their consultants) during the completion of this consultation. These documents and a record of communications are part of the consultation history on file at NMFS.

1.3 Description of the Proposed Action

The USDA-RD proposes to fund, in whole or in part, construction activities to improve the water supply system of the CCE and TSCE. The CCE and TSCE water project involves work at two sites on the Cle Elum River: (1) at the location of an existing CCE water intake and pipeline approximately one mile downstream of Cle Elum Dam (River Mile (RM) 7.0; Lat. 47.2338˚N, Long. 121.0569˚W); and (2) at the location of a proposed new water intake, pumping plant, and transmission line between Old Bullfrog and Bullfrog Roads at RM 1.9 (Lat. 47.1913˚N, Long. 121.0154˚W). Additionally, work on a new intake structure, pumping plant, and transmission line will occur in and along the Yakima River just downstream of the South Cle Elum Bridge at RM 183.1 (Lat. 47.1916˚N, Long. 120.9471˚W).

The CCE and TSCE water project does not involve a new water right, or propose to withdraw additional volume from either the Cle Elum or Yakima River. The proposed new Cle Elum River intake site and transmission system will replace an old, inefficient, and untreated diversion structure and pipeline, and its existing rights will be transferred downstream. This system improvement could result in a short-term reduction in water withdrawn from the Cle Elum River. However, the proposed new Cle Elum River intake site and associated screens are designed to incorporate the potential transfer of water rights, pending the approval of a proposed development project. This future water right transfer and increased withdrawal at the Cle Elum River intake site will not result in a net loss of streamflow from either the Cle Elum or Yakima Rivers (Entrix 2002). Furthermore, the action under consultation does not include adding additional consumptive use to the CCE and TSCE water delivery system. However, if present system inefficiencies relative to the existing Cle Elum River intake and pipeline are transferred to consumptive uses, the result could be a net increase in water diverted out of the Cle Elum River. All sites are located in Kittitas County, WA, and further descriptions of the CCE and TSCE water project elements proposed in both the Yakima and Cle Elum Rivers are presented below.

1.3.1 Yakima River Intake and Associated Elements

1.3.1.1 Intake Structure

A new water intake will be constructed immediately downstream of an existing intake structure, which will be capped, filled with gravel, and decommissioned. The bank of the Yakima River at this location consists of a dike built by the Washington Department of Transportation (WSDOT) to reroute the river in the mid 1960's during the construction of Interstate 90 (Geomax 2002). The new intake will consist of of six precast concrete panels, each measuring 10 feet wide by 17 feet high along the back of the housing, and 10 feet wide by 18 feet high along the front (waterward side) of the intake housing. This structure will be fused to the existing intake, and will occupy approximately 60 linear feet of shoreline. The floor of the intake housing will be flush with the bed of the adjacent river channel. The waterward side of the intake will be equipped with a trash rack to prevent large debris from entering, as well as a stop-log gate to block flow for maintenance purposes and to provide head control as necessary. A precast concrete wing wall will project approximately 20 feet downstream at an oblique angle to help provide appropriate hydraulic conditions in the intake structure.

A cofferdam and silt fence will be constructed around the intake site to isolate the area from adjacent fish-bearing waters. Prior to closure of the cofferdam, fish will be removed from the area by herding and beach seining by a qualified fishery professional. During construction, turbid waters generated within the coffer dam will be pumped to an off-channel wetland mitigation area (constructed as mitigation for wetland lost during construction activities in the spring of 2001) that lacks a surface water connection to the Yakima River. The concrete floor of the intake structure will be cast in-place behind the coffer dam, and will require approximately one foot of excavation across the footprint of the intake housing. A 36-inch diameter outlet pipe will be placed in a trench running from the intake housing to a new pumping plant that will be built atop the levee on the right bank of the river in a previously disturbed area, just east of an existing, obsolete pumphouse. Construction on the new pumping plant could begin as early as July, 2002, pending permit approval and receipt of funds. This element of the proposed action will not involve in-water work, and is not subject to in-water work windows. Best Management Practices (BMP) to control runoff, sediment, and construction-related fuels and lubricants will be in effect. However, site location and the nature of construction activities should entail minimal interaction with the adjacent Yakima River.

Excavation required for the intake housing will disturb approximately 1,200 square feet of shoreline on the barren levee that forms the right bank of the Yakima River, which presently serves as marginal fish habitat. However, a mature cottonwood tree will be removed for construction of the new intake housing. To minimize the effect of losing the tree and shoreline habitat, rooted willow cuttings and cottonwoods will be planted along the dike on the right bank of the Yakima River.

1.3.1.2 Intake Screens

Six 33-inch long by 33-inch diameter Johnson screens with air-burst cleaners will be installed in concrete housings that contain the intake pipes, and will be aligned parallel to the adjacent river channel and intake housing face. Screens will be installed in the isolated environment created by the coffer dam and silt fence described in Section 1.3.1.1, above. Field investigations by Entrix consultants were conducted on February 7, 2002 to identify whether or not modifications to a pinch dike constructed in January, 2001 are necessary to provide adequate sweep velocities past the newly constructed screens. This investigation revealed that a minor amount of modification would be necessary. This modification will entail slight rearrangement of the large rocks that constitute the pinch dike to further constrict flow near the intake (and screen) face to increase sweep velocities. This work will be completed with equipment already on-site for the construction of the intake structure, and will not require any entrance into the Yakima River. It is anticipated that this activity will produce minimal disturbance to the bed of the river, and the effects should be discountable if not completely insignificant.

1.3.1.3 Downstream Rock Barbs

Geomorphic reconnaissance at the outset of this project revealed the presence of an active headcut (bedscarp) approximately 1,750 feet downstream of the South Cle Elum Bridge along the levee that forms the left (north) bank of the Yakima River (Geomax 2002). This geomorphic feature is a product of ongoing base-level adjustments exhibited by the Yakima River in response to channel modifications (*i.e.,* channel relocation, realignment, and revetment) first initiated during development of the Northern Pacific (later, the Burlington Northern Santa Fe (BNSF)) and Milwaukee Road railways, and most recently during the completion of the Interstate 90 corridor between the mid-1960's and early 1970's. An active headcut will migrate in the upstream direction, in this case toward the South Cle Elum bridge and project elements constructed in the winter and spring of 2000-2001 as emergency bridge stabilization measures. As such, the integrity of these elements, and elements of the action under consultation, are endangered by the presence of this downstream bedscarp, as well as the integrity of the levee that forms the bank of the river.

To address this issue, the CCE and TSCE propose to construct three rock barbs in the diked (left) bank of the Yakima River. These barbs will act to turn flow away from the levee, help control bed scour and contain the bedscarp at its present location, and promote a depositional environment along the bank of the river by creating a velocity shadow both upstream and downstream of each barb. This depositional area will foster and protect the growth of riparian vegetation which will, in turn, contribute to the structural integrity of the levee. Additionally, these barbs will provide better fish habitat along the levee than under present conditions by providing velocity refuges for adult and juvenile salmonids.

Construction of the three barbs will require placement of approximately 450 Cubic Yards of rock by a thumbed excavator from atop the bank of the river. To minimize adverse effects to aquatic resources, limited excavation of the streambed will occur, and petroleum-based hydraulic fluids in the excavator will be replaced with mineral oil. Bank excavation will be required to install the keys of each barb, but the bank of the Yakima River in the area affected by this element of the proposed project presently consists of a barren levee composed of large, angular basalt that serves as marginal fish habitat. As such, there should be minimal turbidity associated with barb construction. In comparison to standard levee maintenance techniques (*i.e.*, tail-dumping more large, angular basalt) the installation of rock barbs is a more progressive methodology that promotes natural channel dynamics, provides better fisheries habitat, and encourages bank accretion and establishment of riparian vegetation. During construction, large woody debris (LWD) stockpiled by the CCE will be incorporated into each barb to improve fisheries habitat values. After construction, the keys of each barb will be planted with live willow stakes in an effort to provide better riparian habitat along a relatively barren reach of the Yakima River.

The Yakima River elements of the CCE and TSCE water project are proposed for construction in the fall of 2002, pending permit approval and receipt of funds. Discussions with USDA-RD consultants and the WDFW, after review of the in-water components of the project, led to agreement on a work window beginning on October 1, extending through December 31, unless high discharge in the Yakima River precludes construction. After the coffer dam and silt fence are constructed around the new intake construction site, excavation and construction of the new intake structure will commence. When excavation activities for the new intake are completed, equipment will be shifted to the left (north) bank of the Yakima River for construction of the three rock barbs. The final piece of in-water work will entail repositioning of rocks on the pinch dike directly across from the new intake structure to ensure adequate sweep velocities along the pump screens. This portion of the work will take place after the coffer dam and silt fence are removed, in a free-flowing section of the Yakima River so that sweep velocities at the face of the new intake structure can be monitored as pinch dike rocks are repositioned.

1.3.2 Cle Elum River Intake and Associated Elements

1.3.2.1 Existing Intake Structure

Presently, the only withdrawal site for the CCE off the Cle Elum River exists in the form of an unscreened diversion with limited capabilities (*e.g.*, it can only divert at a maximum rate). This water supply is untreated, and therefore the CCE has been allowed to use this diversion only under emergency conditions. Furthermore, the old intake structure and transmission lines are very old and lead to substantial transmission losses from diversion to use point (Pentec 2000).

After the new intake (described in Section 1.3.2.2) is installed and working properly, the existing intake will be decommissioned. At the request of the USDA Forest Service, the diversion structure itself will not be removed, filled or otherwise disturbed. The intake pipeline will be physically eliminated from contact with the Cle Elum River, all valves and gates will be welded shut, and the pipeline behind the intake structure will be blocked to prevent leakage. All in-water work will be done by hand, and riparian disturbance will be minimal. Finally, the immediate area around the old intake structure, including the degraded left bank of the Cle Elum river below the diversion, will be planted with an assortment of native riparian vegetation.

1.3.2.2 New Intake Structure

A new water intake will be built on the left bank of the Cle Elum River between the bridges on Old Bullfrog and Bullfrog Roads at RM 1.8. This structure will be a smaller version of the intake described in Section 1.3.1.1 (Yakima River Intake), and fish removal, construction staging, and construction methods/mitigation will be accomplished in the same manner.

A 30-inch diameter outlet pipe will be placed in a trench running from the intake housing to a wet well with a new pumping plant that will be built into the south shoulder of Old Bullfrog Road (which has been closed and barricaded for many years). A buried 18" transmission main pipeline will run from the pumphouse, along an electrical transmission line easement, to a new water treatment plant proposed for construction near the CCE. Construction on the new pumping plant could begin in July, 2003, pending permit approval and receipt of funds. This element of the proposed action will not involve in-water work, and is not subject to in-water work windows. Best Management Practices (BMP) to control runoff, sediment, and construction-related fuels and lubricants will be in effect. However, site location and the nature of construction activities should provide minimal interaction with the adjacent Cle Elum River.

Access to this site will initially be provided by an existing gravel road spur originating on Old Bullfrog Road. Where possible, the existing Old Bullfrog Road surface will be used to minimize effects to adjacent riparian vegetation. A new access road to the intake will be required for construction and future maintenance activities. In total, approximately 8,300 square feet of riparian and upland habitat will be disturbed to accomplish construction of the new access road, transmission line from intake to pumphouse, intake structure and pumphouse. In addition, 15 mature cottonwood trees will be removed. All trees in the vicinity of the construction site will be marked prior to destruction, and losses will be recorded by species for future mitigation efforts (Entrix 2002). The entire construction site will be contained within a silt fence, and no wetlands will be destroyed during construction. Additionally, the new intake structure and its associated pumphouse and transmission lines will be more efficient than the existing Cle Elum

River intake (Pentec 2000).

After construction is complete, the old gravel road will be decommissioned and revegetated with native wetland and riparian species. To minimize the effects of the removal of trees during construction, trees will be replanted at a ratio of 6:1 for each species lost. Plantings will take place at the new intake construction site as well as upstream at the old CCE intake site at RM 7.0, as described in Section 1.3.2.1.

1.3.2.3 Intake Screens

Four 27-inch long by 27-inch diameter Johnson screens with air-burst cleaners will be installed in concrete housings that contain the intake pipes, and will be aligned parallel to the adjacent river channel and intake housing face. Screens will be installed in the isolated environment created by the coffer dam and silt fence described in Section 1.3.2.2, above. During construction of the intake, rock drop, and pinch dike (described in Section 1.3.2.4), empirical field measurements will be conducted by an engineer or qualified scientist to ensure that adequate hydraulic conditions (*i.e.*, sweep velocities and water depth) are present. Site-specific modifications will be undertaken at the time of construction to ensure that future in-water work will not be required.

1.3.2.4 Rock Drop Structure

A channel-spanning rock drop (broad-crested weir) will be constructed just downstream of the new Cle Elum River intake structure to ensure continuous flow past the intake over a wide range of streamflow. This structure will be composed of large rock keyed into both banks of the river and equipped with a low-flow boat notch to ensure navigability. The structure will be built out from the banks of the river by a thumbed excavator, and will consist of approximately 20,000 cubic yards of rock (including keys, pinch dike, and low intake channel) covering 3,600 square feet of stream channel. As the structure grows outward, the excavator will rest upon previously placed rocks, thus minimizing the in-channel disturbance footprint. No excavation of the river bottom is anticipated for the rock drop, but a slight amount of excavation may be required at the face of the intake structure for the low intake channel. On the intake (left) side of the rock drop, a pinch dike will be installed to promote adequate hydraulic conditions (i.e., sweep velocities for screens described in Section 1.3.2.3). This pinch dike will consist of the same large basalt as the drop and keys, but will be widest along the downstream axis of the Cle Elum River, thus acting to channel streamflow along the face of the intake. The pinch dike will transition into a low intake channel of large rock that lines the waterward side of the intake structure. This rock lining is important to help control water and substrate past the face of the intake structure.

Key excavation for the ends of the drop structure will require removal and destruction of riparian vegetation. Where possible, trees will be removed with rootwads intact for inclusion into the mid-channel and/or lateral margin areas of the drop structure. LWD incorporated into the rock structures at this location will help provide better habitat for the assemblage of aquatic species in this reach of the Cle Elum River.

The Cle Elum River elements of the CCE and TSCE water project are targeted for construction in the fall of 2003, pending permit approval and receipt of funds. All in-water construction activities, regardless of the year in which they are initiated, will take place in a work window beginning on October 1, extending through November 15.

1.4 Description of the Action Area

Under the ESA, the "Action Area" is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area of the action (50 C.F.R.§ 402.02 and 402.14(h)(2)). For the purposes of this consultation, the Action Area includes all aquatic and riparian habitat along the Cle Elum and Yakima Rivers extending from the old CCE water intake at Cle Elum RM 7.0 downstream, through the confluence of the Cle Elum and Yakima Rivers, to Yakima RM 181.0, approximately two miles below the downstream-most proposed rock barb.

2.0 ENDANGERED SPECIES ACT

2.1 Biological Opinion

The objective of this BO is to determine whether the proposed project is likely to jeopardize the continued existence of the MCR steelhead Evolutionarily Significant Unit (ESU), or result in the destruction or adverse modification of their designated Critical Habitat.

2.1.1 Status of Species and Critical Habitat

The listing status, biological information, and Critical Habitat elements or potential Critical Habitat for the NMFS listed species are described below in Table 1.

Species (Biological Reference)	**Listing Status Reference**	**Critical Habitat Reference**
Steelhead from Washington, Idaho, Oregon and California, (Busby, *et al.* 1996).	The MCR ESU is listed as Threatened under the ESA by NMFS, (64 Fed. Reg. 14517, March 25, 1999).	Critical Habitat for MCR ESU, (65 Fed. Reg. 7764, Feb. 16, 2000).

Table 1. References to Federal Register Notices containing additional information concerning listing status, biological information, and Critical Habitat designations for listed and proposed species considered in this biological opinion.

The proposed action will occur within the designated Critical Habitat of MCR steelhead. Essential features of this Critical Habitat include substrate, water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (65 Fed. Reg.7764, February 16, 2000).

MCR steelhead have been negatively affected by a combination of habitat alteration and hatchery management practices. The four downstream, mainstem dams on the Columbia are perhaps the most significant source of habitat degradation for this ESU. The dams act as a partial barrier to passage, kill out-migrating smolts in their turbines, raise temperatures throughout the river system, and have created lentic refugia for salmonid predators. In addition to dams, irrigation systems have had a major negative effect by diverting large quantities of water, stranding fish, and acting as barriers to passage. Other major habitat degradation has occurred through urbanization and livestock grazing practices (WDF *et al.* 1993; Busby *et al.* 1996; NMFS 1996; 63 Fed. Reg. 11798, March 10, 1998).

Habitat alterations and differential habitat availability (*e.g.*, fluctuating discharge levels) impose an upper limit on the production of naturally spawning populations of salmon and steelhead. The National Research Council Committee (NRCC) on Protection and Management of Pacific Northwest Anadromous Salmonids identified habitat problems as a primary cause of declines in wild salmon runs (NRCC 1996). Some of the habitat effects identified were the fragmentation and loss of available spawning and rearing habitat, migration delays, degradation of water quality, removal of riparian vegetation, decline of habitat complexity, alteration of streamflows and streambank and channel morphology, alteration of ambient stream water temperatures, sedimentation, and loss of spawning gravel, pool habitat and large woody debris (NMFS 1998, NRCC 1996, Bishop and Morgan 1996).

Hatchery management practices are suspected to be a major factor in the decline of this ESU. The genetic contribution of non-indigenous, hatchery stocks may have reduced the fitness of the locally adapted native fish through hybridization and associated reductions in genetic variation or introduction of deleterious (non-adapted) genes. Hatchery fish can also directly displace natural spawning populations, compete for food resources, or engage in agonistic interactions (Campton and Johnston 1985; Waples 1991; Hilborn 1992; NMFS 1996; 63 Fed. Reg. 11798, March 10, 1998).

MCR steelhead population sizes are substantially lower than historic levels, and at least two extinctions are known to have occurred in the ESU. In larger rivers (John Day, Deschutes, and Yakima), steelhead abundance has been severely reduced: it is estimated that the Yakima River had annual run sizes of 100,000 fish prior to the 1960's; however, only 505 adults returned to the basin in 1996 (WDF *et al.* 1993). Across the entire ESU, the wild fish escapement has averaged 39,000 and total escapement 142,000 (includes hatchery fish). The large proportion of hatchery fish, concurrent with the decline of wild fish, is a major risk to the MCR ESU (WDF *et al.* 1993; Busby *et al.* 1996; 63 Fed. Reg. 11798, March 10, 1998).

Within the Yakima River Basin, wild adult steelhead returns have averaged 1,488 fish (range 505 (1996) to 2,885 (2001)) over brood years 1985-2001 as monitored at Prosser Dam ((RM 47.1); YSS 2001, with Yakima-Klickitat Fisheries Program (YKFP) brood year 2001 data from www.ykfp.org). Steelhead spawning varies across temporal and spatial scales in the Yakima Basin as well, although the present spatial distribution is significantly decreased from historic conditions. Hockersmith *et al.* (1995) identified the following spawning populations within the

Yakima Basin: upper Yakima River above Ellensburg, Teanaway River, Swauk Creek, Taneum Creek, Roza Canyon, mainstem Yakima River between the Naches River and Roza Dam, Little Naches River, Bumping River, Naches River, Rattlesnake Creek, Toppenish Creek, Marion Drain, and Satus Creek. Typically, steelhead spawn earlier at lower, warmer elevations than higher, colder waters. Overall, most spawning is completed within the months of January through May (Hockersmith *et al.* 1995), although steelhead have been observed spawning in the Teanaway River (RM 176.1), a tributary to the Upper Yakima into July (Todd Pearsons, Washington Department of Fisheries and Wildlife (WDFW), personal communication). These steelhead spawn later in the year at higher elevations in the Yakima basin, and face lethal conditions (in most years) as emigrating kelts (spawned-out adults returning to the ocean) in the lower Yakima River. MCR steelhead that spawn in the Yakima basin at lower elevations potentially meet the same fate, however earlier spawn timing and emigration may provide increased survival because kelts traverse the lower Yakima River before water quality becomes lethal. High temperatures, low flows, and degraded water quality from irrigation effluents (*i.e.*, high temperature, turbidity and pollutant concentrations), contribute to extremely low survival during summer months (Vaccaro 1986; Lichatowich and Mobrand 1995; Lichatowich *et al.* 1995; Pearsons *et al.* 1996; Lilga 1998).

Four genetically distinct spawning populations of wild steelhead have been identified in the Yakima basin, one of which spawns in the upper Yakima River and its tributaries (Phelps *et al.* 2000). Hockersmith *et al.* (1995) found that 3% of radio-tagged steelhead from 1990 to 1992 utilized the upper mainstem Yakima River and its tributaries for spawning, beginning in early March and extending into late May. Busack *et al.* (1991) analyzed scale samples from smolts and adult steelhead and found, generally, that smoltification occurs after two years in the Yakima system, with a few fish maturing after three years and an even smaller proportion reaching the smolt stage after one year. These data suggest that listed steelhead could be present in the Action Area virtually every day of the calendar year. Within the Yakima River basin, the Upper Yakima subpopulation of steelhead contributes to the run as a whole, both in terms of numbers and genetic diversity.

The upper Yakima (and subsequently the Cle Elum River) steelhead population was undoubtedly adversely affected by operations at Roza Dam (RM 128) between 1941 and 1959. Although fitted with a ladder, the pool at Roza Dam was kept down from the end of one irrigation season (mid-October) to the beginning of the next (mid-March) for these 18 years. Hockersmith *et al.* (1995) found that steelhead passed Roza Dam from November through March, and more recent data suggest that passage occurs from the end of September through May (Mark Johnston, Yakama Nation Fisheries Program, personal communication). Consequently, operations at Roza Dam virtually eliminated fish passage for most of the steelhead migration season, and excluded most steelhead bound for the upper Yakima from reaching their destination. A new ladder was installed at Roza Dam in 1989 that allows better passage, but only when the pool is completely up or down. However, the ladder is inoperable at levels between maximum and minimum pool when the reservoir is manipulated to facilitate operational activities such as screen maintenance at the end of October and early November.

2.1.2 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA and 50 C.F.R. Part 402 (the consultation regulations). NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify Critical Habitat. This analysis involves the initial steps of (1) defining the biological requirements and present status of the listed species, and (2) evaluating the relevance of the environmental baseline to the species' present status.

From that, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of injury or mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed species' life stages that occur beyond the Action Area. If NMFS finds that the action is likely to jeopardize, NMFS must identify reasonable and prudent alternatives for the action.

Furthermore, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated Critical Habitat. NMFS must determine whether habitat modifications appreciably diminish the value of Critical Habitat for both survival and recovery of the listed species. NMFS identifies those effects of the action that impair the function of any essential element of Critical Habitat. NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will adversely modify Critical Habitat it must identify any reasonable and prudent alternatives available.

Guidance for making determinations on the issue of jeopardy and adverse modification of habitat are contained in *The Habitat Approach, Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids*, August 1999 (available online at: www.nwr.noaa.gov/1habcon/habweb/pubs/newjeop9.pdf).

For the proposed action, NMFS' jeopardy analysis considers direct or indirect mortality of fish attributable to the action. NMFS' Critical Habitat analysis considers the extent to which the proposed action impairs the function of essential elements necessary for migration and spawning of the listed salmon under the existing environmental baseline.

2.1.2.1 Biological Requirements

The first step in the methods NMFS uses for applying the ESA Section 7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. NMFS also considers the present status of the listed species; taking into account population size, trends, distribution and genetic diversity. To assess the present status of the listed species, NMFS starts with the determinations made in its original decision to list the species (*i.e.*, MCR steelhead) for protection under the ESA. Additionally, the assessment will consider any new information or data that are relevant to the determination (see Table 1 for references).

The relevant biological requirements are those necessary for salmon in each ESU to survive and recover to naturally reproducing population levels, at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

The biological requirements of MCR steelhead include food, flowing water (quantity), high quality water (cool, free of pollutants, high dissolved oxygen concentrations, low sediment content), clean spawning substrate, and unimpeded migratory access to and from spawning and rearing areas (adapted from Spence *et al.* 1996). Even slight modifications of these habitat elements can produce deleterious effects to MCR steelhead and their Critical Habitat.

NMFS has related the biological requirements for listed salmonids to a number of habitat attributes, or pathways, in the Matrix of Pathways and Indicators ((MPI); available online at: www.nwr.noaa.gov/1habcon/habweb/pubs/matrix.pdf). These pathways (Water Quality, Habitat Access, Habitat Elements, Channel Condition and Dynamics, Flow/Hydrology, and Watershed Conditions) indirectly measure the baseline biological health of listed salmon populations through the health of their habitat. Specifically, each pathway is made up of a series of individual indicators (*e.g*., indicators for Water Quality including Temperature, Sediment/Turbidity, and Chemical Contamination/Nutrients) that are measured or described directly (see, NMFS 1996). Based on the measurement or description, each indicator is classified within a category of the properly functioning condition (PFC) framework: (1) *properly functioning*, (2) *at risk*, or (3) *not properly functioning*. Properly functioning condition is defined as "the sustained presence of natural habitat forming processes in a watershed that are necessary for the long-term survival of the species through the full range of environmental variation."

2.1.2.2 Factors Affecting the Species at the Population Level

In other Biological Opinions, NMFS assessed life history, habitat and hydrology, hatchery influence, and population trends in analyzing the effects of the underlying action on affected species at the population scale (see, for example, Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, NMFS 2000.) A thumbnail description of each of these factors for the MCR steelhead ESU is provided below.

2.1.2.2.1 Life History

Most fish in this ESU smolt at 2 years and spend 1 to 2 years in salt water before reentering freshwater, where they may remain up to a year before spawning (Howell et al. 1985). All steelhead upstream of The Dalles Dam are summer-run (Schreck et al. 1986, Reisenbichler et al.

1992, Chapman et al. 1994). The Klickitat River, however, produces both summer and winter steelhead, and age-2-ocean steelhead dominate the summer steelhead, whereas most other rivers in the region produce about equal numbers of both age-1- and 2-ocean fish. A nonanadromous form co-occurs with the anadromous form in this ESU; information suggests that the two forms may not be isolated reproductively, except where barriers are involved.

2.1.2.2.2 Habitat and Hydrology

Substantial habitat blockages are present in this ESU. While Pelton Dam on the Deschutes River may represent one of the most significant, minor habitat blockages occur throughout the region. In the Yakima basin, Cle Elum, Rimrock, and Bumping Dams are examples of storage projects that have blocked many miles of formerly utilized habitats since the early part of the Twentieth century. Water withdrawals and overgrazing have seriously reduced summer flows in the principal summer steelhead spawning and rearing tributaries of the Deschutes River. This is significant because high summer and low winter water temperatures are limiting factors for salmonids in many streams in this region (Bottom et al. 1985).

2.1.2.2.3 Hatchery Influence

Continued increases in the proportion of stray steelhead in the Deschutes River basin is a major concern. The Oregon Department of Fish and Wildlife (ODFW) and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) estimate that 60% to 80% of the naturally spawning population consists of strays, which greatly outnumber naturally produced fish. Although the reproductive success of stray fish has not been evaluated, their numbers are so high that major genetic and ecological effects on natural populations are possible (Busby et al. 1999).

The negative effects of any interbreeding between stray and native steelhead will be exacerbated if the stray steelhead originated in geographically distant river basins, especially if the river basins are in different ESUs. The populations of steelhead in the Deschutes River basin include the following:

- Steelhead native to the Deschutes River
- Hatchery steelhead from the Round Butte Hatchery on the Deschutes River
- Wild steelhead strays from other rivers in the Columbia River basin
- Hatchery steelhead strays from other Columbia River basin streams

Regarding the latter, CTWSRO reports preliminary findings from a tagging study by T. Bjornn and M. Jepson (University of Idaho) and NMFS suggesting that a large fraction of the steelhead passing through Columbia River dams (e.g., John Day and Lower Granite dams) have entered the Deschutes River and then returned to the mainstem Columbia River. A key unresolved question about the large number of strays in the Deschutes basin is how many stray fish remain in the basin and spawn naturally.

2.1.2.2.4 Population Trends and Risks

For the MCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[1] ranges from 0.88 to 0.75, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (McClure et al. 2001). NMFS has also estimated the risk of absolute extinction for four of the spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Umatilla River and Deschutes River summer runs (McClure et al. 2001). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Deschutes River summer run (McClure et al. 2001). However, with respect to the Yakima River extinction risk, the estimates are extremely optimistic because of the nature of the source data and sparse information on hatchery fish (Michelle McClure, NOAA-NMFS Northwest Fisheries Science Center, personal communication).

2.1.2.3 Factors Affecting the Species within the Action Area

Section 4(a)(1) of the ESA and NMFS listing regulations (50 C.F.R. 424) set forth procedures for listing species. The Secretary of Commerce must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors; (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

The proposed action includes activities that will have some level of effects with short-term effects from category (1) in the above paragraph, and the potential for long-term effects as described in category (5). The characterization of these effects and a conclusion relating the effects to the continued existence of MCR steelhead is provided below, in Section 2.1.3.

The major factors affecting steelhead within the Action Area include instream flows, channel conditions and dynamics, and riparian habitat. NMFS uses the Matrix of Pathways and Indicators (MPI) to analyze and describe the effects of these factors on listed steelhead. As described above, the MPI relates the biological requirements of listed species to a suite of habitat variables. In the MPI analysis presented here, each factor is considered in terms of its effect on relevant pathways and associated indicators (*properly functioning, at risk, or not properly functioning*).

---

[1]Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period that varies between spawning aggregations. Population trends are projected under the assumption that all conditions will stay the same into the future.

2.1.2.3.1 Instream Flows

Instream flows in the Cle Elum and Yakima Rivers within the Action Area are mostly controlled by natural watershed processes (snowmelt runoff and rain-on-snow events), but more significantly by the operation of Bureau of Reclamation (BOR) storage reservoirs (e.g., Keechelus, Kachess, Cle Elum, and Easton). In an unregulated condition, the Yakima and Cle Elum Rivers would exhibit the hydrographs of snowmelt-dominated systems where discharge peaked in May concurrent with melting snow, and reached baseflow in late July. Discharge would have increased in early winter, as precipitation in the form of rainfall (and early snowmelt, to some degree) augmented summer baseflow (Kinnison and Sceva 1963).

Presently, the Yakima and Cle Elum Rivers are manipulated to maximize winter reservoir storage and summer irrigation deliveries that are synchronized with the seasonal needs of irrigators. However, in most cases, reservoir operations produce streamflows across the basin that are asynchronous with the life-history requirements of aquatic species assemblages. Large volumes of water are released into the Yakima and Cle Elum Rivers throughout the summer months (irrigation season), peaking in mid to late August. In early September, through a process known as "flip-flop," releases from reservoirs (primarily Keechelus, Kachess, Cle Elum and Easton) in the "Yakima Arm" (the Yakima River above the Naches River confluence) of the system are ramped down to a fraction of their August discharge levels in an attempt to minimize the dewatering of spring chinook redds during winter storage operations (downstream to Roza Dam). Downstream irrigation deliveries are then primarily met from Rimrock and Bumping Reservoirs in the "Naches Arm" (the Naches River and its tributaries) of the system, which equates to abnormally high discharge levels in the Tieton and Naches Rivers thorough the middle of October–the traditional end of the irrigation season.

The flip-flop operation involves a radical flow manipulation in reaches of the Cle Elum River below Cle Elum Dam, and the Upper Yakima River below Keechelus, Kachess, and Easton Dams. For example, in the Cle Elum River, discharge levels can range from approximately 3,000 cfs in late August to less than 250 cfs by the second week of September. The same large magnitude flow fluctuation is also expressed in the Yakima River in the Action Area. After spring chinook finish spawning, incubation (*i.e.*, winter) flows are further reduced from those flows released in September. Minimal discharge is released from BOR reservoirs during the winter in an effort to maximize reservoir storage. Generally, inflow exceeds outflow throughout the winter until reservoir storage reaches elevations where releases are made per flood rule curves. BOR reservoirs are operated to maximize storage levels by late May, just before deliveries for irrigated agriculture begin, usually in late June or early July. Additionally, alteration of the natural hydrograph has altered sediment transport relationships important to channel morphology and salmonid ecology.

Reservoir operations in the Upper Yakima and Cle Elum Rivers have inverted and truncated the natural hydrograph, produced river systems that are out of phase with their natural hydrographs, and the biota of these systems have suffered accordingly. This storage-and-release pattern is at best suboptimal for adult and juvenile steelhead (Fast *et al.* 1991). In the MPI analysis, instream flows fall under the Flow/Hydrology pathway, and Change in Peak/Base flow indicator. Presently, for the reasons described above, this indicator is *not properly functioning*. In this instance, *not properly functioning* is defined as "pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology, and geography."

2.1.2.3.2 Riparian Habitat

Forest practices, agriculture, urbanization, and flood control have adversely affected riparian habitat in the Upper Yakima and Cle Elum River watersheds. In the Action Area of this project, numerous anthropogenic features or activities (*e.g.*, channelized, armored, realigned and relocated Yakima River reach below South Cle Elum Bridge, Bonneville Power Administration (BPA) transmission line crossings, levees, local roads (both parallel to and across the Yakima and Cle Elum Rivers), railroad operations, tie drives, and urban development) have become permanent fixtures on the landscape and have displaced and altered native riparian habitat to some degree. Consequently, the potential for normal riparian processes (*e.g*., shading, bank stabilization and LWD recruitment) to occur is diminished, and aquatic habitat has become simplified (Ralph *et al.* 1994; Young *et al.* 1994; Fausch *et al.* 1994; Dykaar and Wigington 2000).

The Yakima River reach throughout most of the Action Area has extremely degraded riparian habitat primarily because of construction activities undertaken in the 1880's and early 1900's as the Northern Pacific (later, the BNSF) and Milwaukee Road railways were built along both sides of the floodplain, and most recently during the completion of the Interstate 90 corridor between the late 1960's and early 1970's. In both cases, the river was removed or displaced from its natural channel and placed in an armored channel engineered to convey large quantities of water and protect local infrastructure. Presently, the presence of the BNSF railroad grade, road (Interstate 90 and local roads) prisms, and channel-bracketing levees have left the area relatively barren of native riparian habitat. When coupled with flow management scenarios (refer to Section 2.1.2.3.1), physical processes that promote regeneration and growth of native riparian vegetation have been severely altered.

Riparian habitat in the Cle Elum River reach of the Action Area is also degraded, but to a lesser extent than previously described in the Yakima River. Two road crossings upstream and downstream of the proposed new intake structure have displaced native riparian habitat, and altered floodplain-stream channel relationships. Upstream of the proposed intake structure, there exists relict reaches of braided, alluvial floodplain habitats that are also degraded with respect to structure and function.

In the MPI analysis, the alteration of riparian vegetation affects several pathways and indicators. For the Cle Elum River reach of the Action Area, the Watershed Conditions pathway and Riparian Reserves indicator is functioning *at risk*: there has been a moderate loss of connectivity or function (shade, LWD recruitment, etc.) of the riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species. For the Yakima River reach of the Action Area, the Watershed Conditions pathway and Riparian Reserves indicator *is not properly functioning*: the riparian reserve system is fragmented, poorly connected, and provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact). In addition, the Temperature and Large Woody Debris indicators, from the Water Quality and Habitat Elements pathways, are also functioning *at risk* (Cle Elum River) or *not properly functioning* (Yakima River) because of impaired riparian function.

2.1.2.3.3 Channel Condition and Dynamics

Alluvial channel patterns adjust by lateral planform migration and longitudinal profile changes through aggradation and degradation (Leopold *et al.* 1964; Dunne and Leopold 1978; Alabyan and Chalov 1998). As such, the river has a natural tendency to respond to flood events by occupying distributary channels, dissipating excessive erosive energy, rebuilding floodplain habitats, and recharging the shallow alluvial aquifer. The Action Area of this project contains relict (Yakima River reach) and relatively intact (upper Cle Elum River reach) braided, alluvial floodplain reaches that have been shown to be centers of biological production and ecological diversity (Stanford and Ward 1988).

Numerous anthropogenic influences in the Action Area have either intentionally or unintentionally altered the structure, function, and interaction of the Cle Elum and Yakima Rivers and their adjacent floodplain ecosystems. These alterations are most striking in the Yakima River reach of the Action Area, but are also present at lesser magnitude in the Cle Elum reach of the Action Area. Diking, channel armoring, channelization and highway and railroad construction (both parallel to and across both Rivers) has isolated many side channels and sloughs important to the ecology of salmonids and other native aquatic species assemblages. These floodplain revetments have greatly inhibited the exchange of hyporheic waters, isolated and truncated hyporheic habitats, and greatly simplified salmonid and macroinvertebrate habitats. Additionally, floodplain anthropogenic activities, in combination with surface-water management scenarios, have served to alter the natural exchange of waters between the shallow alluvial aquifer of glacial deposits and the Yakima and Cle Elum Rivers.

Such floodplain developments were undertaken to protect the local infrastructure. However, these floodplain revetments also had a negative effect on fisheries resources through simplification and homogenization of littoral and riverine habitat, disconnecting the Yakima and Cle Elum Rivers from their floodplains, reducing channel complexity, and altering the flow regime under which aquatic species and riparian vegetation evolved (Dykaar and Wigington 2000). As a result, in the Cle Elum River reach of the Action Area, the Floodplain Connectivity and Width/Depth Ratio indicators (Channel Condition and Dynamics pathway) are functioning *at risk*. In this instance, *at risk* is defined as “reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.” Additionally, the Off-channel Habitat indicator (Watershed Condition pathway) is functioning *at risk*, because only “some backwaters and high energy side channels” presently exist.

In the Yakima River reach of the Action Area, the Floodplain Connectivity and Width/Depth Ratio indicators (Channel Condition and Dynamics pathway) are *not properly functioning*. In this instance, *not properly functioning* is defined as "severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly." Additionally, the Off-channel Habitat indicator (Watershed Condition pathway) is *not properly functioning*, because "few or no backwaters, off-channel ponds, or low energy off-channel areas" presently exist.

2.1.2.4 Environmental Baseline

The environmental baseline represents the present basal set of conditions to which the effects of the proposed action would be added. The term "environmental baseline" means "the past and present effects of all Federal, state, or private actions and other human activities in the Action Area, the anticipated effects of all proposed Federal projects in the Action Area that have already undergone formal or early Section 7 consultation, and the effect of state or private actions which are contemporaneous with the consultation in process " (50 C.F.R. 402.02). As described above in Section 1.4, the Action Area for this project extends from RM 7.0 on the Cle Elum River downstream, through the confluence of the Cle Elum and Yakima Rivers, to Yakima RM 181.0, approximately two miles below the downstream-most construction element.

The headwaters of the Yakima and Cle Elum Rivers emerge from the crest of the Cascade Mountains above Keechelus and Cle Elum Lakes, respectively. The Cle Elum River flows approximately 26 miles from its drainage divide where it is then impounded by Cle Elum Dam. From the outlet of the dam, it flows approximately 8.2 miles to its confluence with the Yakima River, ultimately draining a 221 mi^2 catchment basin. From there, the Yakima River flows approximately 185.6 miles downstream to Richland, Washington where it enters the Columbia River at RM 335.2. Total Yakima River drainage basin area is roughly 6,155 square miles, encompassing over 1,900 miles of perennial streams. Major tributaries below the Action Area include the Teanaway River in the upper basin, the Naches River in the mid part of the basin, and Ahtanum, Toppenish, and Satus Creeks further downriver.

The Yakima basin occupies two physiographic provinces (the Columbia Plateau and Cascade Mountains), and three major ecoregions (Cascades, Eastern Cascades Slopes and Foothills and Columbia Basin (Omernik 1987)). Consequently, climate, topography, precipitation, and vegetative cover are highly variable. In addition, the distribution and type of aquatic and terrestrial habitat is quite variable, supporting a wide range of species. With respect to anadromous fishery resources, the Yakima Basin once supported abundant and diverse runs of salmon and steelhead that now return in just a fraction of their historic numbers (Nehlsen *et al.* 1991; Tuck 1995; Busby *et al.* 1996; NMFS 1996).

At the downstream end of the Action Area, the Yakima River drains approximately 495 square miles of predominately forested, mountainous terrain of the Cascades. Pacific silver fir, western hemlock, western red cedar, Douglas fir, lodgepole and white pine inhabit the upland portions of the area. Riparian species include cottonwood, Douglas fir, western hemlock and red cedar, alder, and willow. Wetland areas support sedges, rushes, and mannagrass; scrub-shrub wetlands harbor willow, alder, and/or spirea; while marsh areas host cattails and bulrushes.

Average gradient for the Yakima and Cle Elum Rivers through the Action Area is approximately 0.36%. River and floodplain morphology is largely composed of single-thread and braided channels that occupy alluvial floodplains of glacial origin (*e.g.*, outwash and morainal material). Glacial moraines and anticlinal bedrock outcrops largely control the horizontal and vertical positions of the two rivers, and the floodplain location of each stream channel (although more so in the Yakima River) appears to be strongly influenced by tectonic tilting to the northeast (Geomax 2002). Anthropogenic activities in the floodplain of the Yakima River, including railway and highway construction, have leveed, armored, realigned, and shortened the historic channel, virtually eliminating natural river-floodplain interactions. The Cle Elum River at the site of the proposed CCE and TSCE water intake is caught on a basalt bedrock block at the toe of Easton Ridge, and channel morphology is additionally controlled by the presence of two cross-floodplain road prisms.

Two tributaries, Crystal Creek and Tillman Creek, enter the Yakima River in the Action Area. Other perennial and ephemeral tributaries have been cut off by railroad grades, local roads and infrastructure. One named intermittent tributary, Domerie Creek, enters the Cle Elum River in the Action Area. Other unnamed, ephemeral tributaries intersect the Cle Elum River, but do not contribute appreciable flow, or provide permanent fish habitat. The primary land use in the area is timber harvest; secondary land uses include recreation, winter sports, and grazing.

Water quality in the Action Area is generally good, primarily because of watershed position and relatively low levels of development in the area (HLA 2001). Land-use activities (roading, grazing, and forest practices) have deteriorated factors such as sediment cycling and nutrient delivery. With respect to water temperature, bottom-draw release structures like those used at Cle Elum, Keechelus and Kachess Dams provides thermally homogeneous, cold discharge to the Yakima and Cle Elum Rivers, and may interfere with certain aspects of salmonid ecology in the Action Area (*e.g.*, migration cues, spawn timing, and growth). However, the effect of this mechanism on salmonid ecology has not been empirically evaluated.

Threatened MCR steelhead are presently affected by a number of habitat modifications within the Action Area. The most prominent and deleterious modifications are the result of reservoir storage and irrigation activities, as well as development in the floodplain, riparian, and upland areas. Specifically, irrigation and development have had the following effects on the environmental baseline: (1) adversely affected instream flows, (2) degraded floodplain and streambank morphology and function, and (3) detached portions of the Yakima River and its tributaries from their historical floodplains creating impaired floodplain function.

Instream flow related BOR Yakima Project operations, pursuant to delivery of irrigation demands, have greatly affected biotic and abiotic conditions in the Cle Elum and Yakima Rivers in the Action Area. Generally, instream flow problems stem from chronically low discharge levels during reservoir refill periods to inordinately high flows out of phase with the ecology of steelhead when downstream demands are being met. Steelhead spawning flows in the Cle Elum and Yakima Rivers can be depressed by low discharge levels if low snowpack and runoff extend reservoir refill periods. Incubation, fry, and juvenile rearing conditions can be problematic as high discharge levels produce high velocity habitats that can displace individuals downstream. In addition, high discharge levels during the summer months can produce rearing conditions that are energetically stressful to juvenile fish, stunting their growth and maturity to smoltification. Spring chinook salmon spawn in the Cle Elum and Yakima Rivers during high irrigation delivery flows (August to Mid-September) that are cut by more than 90% for incubation discharge levels (mid-October through early spring). These incubation flows also dewater side-channel habitats that are important to the juvenile life-stage of all salmonids.

Floodplain development and revetments, the realignment, channelization and armoring of the Yakima River near the CCE, and floodplain roads in both the Cle Elum and Yakima Rivers have altered natural processes that served to (1) promote exchange of water and sediments between the rivers and their overbank habitats, (2) provide lateral habitat heterogeneity for MCR steelhead, and (3) maintain riparian habitat communities dependent on natural streamflow dynamics. As described in the preceding paragraph, flow management scenarios have served to exacerbate floodplain function problems.

Throughout the Action Area, riparian habitat has been degraded through a variety of activities. Among them, timber harvest, roading (both parallel to and across the river), diking, grazing, urban development, and flood control have had the greatest effect. These activities have degraded riparian habitat by direct canopy removal, covering the ground with materials that preclude plant growth, reducing the widths of riparian zones, and altering the riparian species composition in favor of nonnative plants. For MCR steelhead, the lack of properly functioning riparian habitat contributes to instream temperatures that may seasonally exceed physiological tolerances and streambank erosion that increases sedimentation of spawning habitat. Additionally, degraded riparian zones contribute an inadequate amount of LWD, and subsequently prevent or inhibit habitat forming processes such as pool formation and establishment of instream cover. Although the Yakima and Cle Elum Rivers in the Action Area exhibit some intact floodplain riparian habitats, flow management practices provide discharge out of phase with the natural hydrograph that is temporally incompatible with salmonid life stage, riparian, and hyporheic species' requirements.

Based on the above information, NMFS concludes that not all of the biological requirements of listed steelhead for freshwater habitat in general are being met under the environmental baseline in this watershed. The status of the species is such that there must be significant improvement in the environmental conditions they experience over those presently available under the environmental baseline to meet the biological requirements for survival and recovery of this species. Further degradation of these conditions could significantly reduce the likelihood of survival and recovery of this species because of the amount of risk listed steelhead already face under the present environmental baseline.

2.1.3 Effects of the Proposed Action

NMFS' ESA implementing regulations define "effects of the action" as "the direct and indirect effects of an action on the species or Critical Habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." Direct effects are immediate effects of the project on the species or its habitat, and indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur (50 C.F.R.§ 402.02).

2.1.3.1 Direct Effects

Direct effects result from the agency action and may include the effects of interrelated and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated. The direct effects resulting from the proposed CCE and TSCE water project include (1) possible increase in turbidity pursuant to construction activities, (2) disturbance of the streambed and banks, and (3) alteration of geomorphic floodplain interactions in both the Cle Elum and Yakima Rivers.

<u>2.1.3.1.1 Turbidity</u>

Instream excavation, bank excavation, rock placement, and other activities associated with the installation of rock barbs, water intakes and rock drop structures in the Cle Elum and Yakima Rivers will mobilize sediments and temporarily increase downstream turbidity levels. In the immediate vicinity of the construction activities (several hundred feet), the level of turbidity will likely exceed the natural background levels by a significant margin and potentially affect listed MCR steelhead.

For salmonids, turbidity has been linked to a number of behavioral and physiological responses (i.e., gill flaring, coughing, avoidance, increase in blood sugar levels) which indicate some level of stress (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985; Servizi and Martens 1992). The magnitude of these stress responses is generally higher when turbidity is increased and particle size decreased (Bisson and Bilby 1982; Servizi and Martens 1987; Gregory and Northcote 1993). Although turbidity may cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity accelerate foraging rates among juvenile chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

When the particles causing turbidity settle out of the water column, they contribute to sediment on the riverbed (sedimentation). When sedimentation occurs, salmonids may be negatively affected: (1) buried salmonid eggs may be smothered and suffocated, (2) prey habitat may be displaced, and (3) future spawning habitat may be displaced (Spence *et al.* 1996). Additionally, turbidity and subsequent sedimentation can affect the quality of stream substratum as spawning material, influence the exchange of streamflow and shallow alluvial groundwater, occupy channel storage areas for cobbles and gravels, increase width-depth ratios, depress riverine productivity, and contribute to decreased salmonid growth rates (Waters 1995; Newcombe and Jensen 1996; Shaw and Richardson 2001).

The CCE and TSCE project will cause elevated turbidity levels during the instream construction period and for several days afterwards. The initial placement of boulders for coffer dams, barbs, and drop structures, and bank excavation for drop structure keys will cause a temporary spike of sediment influx above background levels only moderate in magnitude. However, the effects of this turbidity on listed fish will be minimized by (1) constructing coffer dams around proposed water intake sites that will isolate work areas from adjacent flowing water, (2) excavating for rock barbs in leveed reaches (*i.e.*, banks composed of large rock are low in fine sediment concentration), (3) excavating rock drop structure keys by beginning behind (*i.e.*, away from the stream channel) the existing bank and progressing waterward, (4) minimizing bed excavation for rock barbs and drop structures (as is presently proposed), (5) limiting in-water entry by large equipment (*e.g.*, rock barbs will be constructed without tracked vehicle entry in to the Yakima River) and (6) performing in-water construction activities during low-flow periods (October through December in 2002, October to mid-November thereafter).

Instream turbidity will be minimized if not totally obviated because construction activities relative to water intake construction will be carried out in an isolated environment after fish have been removed, and turbid water will be pumped onto adjacent upland areas. It is also expected that listed fish present during the initial phases of construction will temporarily move to refuges where turbidity can be avoided, thus preventing injury or death. Additionally, the project work window will capitalize on a time of the year when spawning MCR steelhead or redds are not present, and adult fish are most likely migrating in small numbers. Because the proposed barbs in the Yakima River reach of the Action Area are designed to stabilize the streambank and levee and retain sediments, it is unlikely that they will cause long-term sedimentation problems in the Action Area. Instead, the barbs are likely to reduce baseline erosion rates and decrease associated turbidity and sedimentation in the future. The rock drop structure in the Cle Elum River reach of the Action Area should have no long-term effects on turbidity and sedimentation rates in the future. Repositioning large rocks on the Yakima River intake pinch dike after the intake is constructed is expected to produce discountable and insignificant turbidity levels, both in the short and long-term.

It is expected that turbidity and sedimentation caused by this action will be short lived, returning to baseline levels soon after construction is over, and long term effects (*i.e.*, adverse modification of critical habitat) will not occur. Other than the short term inputs mentioned above, this project will not change or add to the existing baseline turbidity or sedimentation levels within the Action Area. It is possible that rock barb construction on the Yakima River reach of the Action Area will serve to slightly improve long-term sedimentation (Water Quality Pathway) conditions by promoting levee integrity and streambed dynamics that approach a more natural condition that is presently occurring.

2.1.3.1.2 Streambed and Bank Disturbance

The construction elements of the CCE and TSCE water project will disturb the existing substrate present in the river, and require varying amounts of bank disturbance. The primary mechanisms of disturbance will be rock placement, instream excavation, bank excavation to key in the rock barbs, drop structure and intake structures, and floodplain perturbation to build pumping plants transmission lines, and an access road.

As previously stated, herbaceous and woody material will be removed to facilitate construction of the rock barbs and drop structures. At the Cle Elum intake construction site, approximately 15 mature black cottonwood trees will be removed to facilitate the installation of the intake structure, transmission lines, pumping plant, and access road. Where possible, trees will be removed with rootwads intact for inclusion into the mid-channel and/or lateral margin areas of the drop structure. LWD incorporated into the rock structures at this location will help provide better habitat for the assemblage of aquatic species in this reach of the Cle Elum River.

Construction activities in the Yakima River reach of the Action Area will disturb armored banks that comprise a channel-bracketing levee composed of large, angular basalt rip-rap largely barren of riparian vegetation. Post-construction revegetation work will provide an overall net gain in riparian vegetation within the project area. The creation of a depositional environment by barb construction along the base of the levee will further promote the establishment and maintenance of riparian vegetation.

The direct effect on MCR steelhead as a function of streambed disturbance is expected to be minor. Because of the project work window, MCR steelhead life stages in the project area include juvenile and young-of-the-year (YOY) fish that are resident in the water column and are able to evacuate the area when disturbance is initiated. The most significant effect would be the temporary loss (burial or displacement) of some potential prey species (invertebrates) and their habitat.

Invertebrates (e.g., larval insects, obligate aquatic insects, molluscs, crustaceans etc.) recolonize disturbed areas by drifting, crawling, swimming, or flying in from adjacent areas (Mackay 1992). The time required for new invertebrates to reach pre-disturbance abundance levels and equilibrium would be related to the spatial scale of their initial habitat loss, the persistence of the excluding or disturbing mechanism, the size of adjacent or remnant invertebrate populations (potential colonizers), the season in which the disturbance is taking place, and the life history characteristics of the invertebrate species (Mackay 1992).

Lost foraging opportunities resulting from the disturbance of Cle Elum and Yakima River bedforms will likely be short-lived as invertebrates will recolonize the disturbed substrate (Allan 1995). Long-term effects to prey abundance and habitat are not predicted because (1) limited excavation of each streambed is required, (2) the fall work window coincides with high levels of invertebrate activity (and therefore recolonization potential), and (3) following construction, new riverbed materials will resemble pre-disturbance habitat (i.e., benthic habitat will not be permanently displaced). The rock structures should not reduce the long-term functional quality of juvenile foraging habitat in the Action Area.

2.1.3.1.3 Floodplain Alteration

The in-water construction elements of the CCE and TSCE water project will alter geomorphic floodplain interactions in the Cle Elum and Yakima Rivers. Riverine structure and function are determined by the changing temporal interaction of the physical, chemical, and biological components of a river, along three physical dimensions: longitudinal (headwaters to downstream), vertical (water circulation into bed sediments of the channel and floodplain), and horizontal (water circulation onto and from floodplains) (Hynes 1983; Ward and Stanford 1995b). Floodplains, their riparian wetlands, and interconnected mosaics of aquatic and semi-aquatic habitats are integral components of rivers (Stanford and Gonser 1998), and the species that depend upon them for survival (Minshall *et al.* 1985; Stanford *et al.* 1996). Disconnecting river channels from their floodplain habitats by flow regulation and/or revetment can compromise the ecological integrity of riverine ecosystems (Sedell *et al.* 1990; Stanford and Hauer 1992; Ward and Stanford 1995a). Altering the runoff regime or channel hydraulics under which streams developed can produce channel forms that are dissimilar to the natural condition (Leopold *et al.* 1964), which can have corresponding detrimental effects to the organisms that coevolved within the same river system (Vannote *et al.* 1980; Wallace *et al.* 1982; Minshall *et al.* 1983).

The three rock barbs proposed for installation into the levee on left bank of the Yakima River near the South Cle Elum Bridge are intended to turn the river away from the streambank, and promote a depositional environment that will protect the integrity of the streambank and levee, promoting the reestablishment of riparian vegetation. Over time, as the barbs experience a range of higher discharge, the thalweg of the Yakima River will move away from the levee. Scour pools will develop at the toe of each respective barb, providing holding cover for adult and rearing cover for juvenile salmonids. Although the Yakima River is confined by channel-bracketing levees in this reach, it appears to be attempting a meander pattern in other adjacent reaches without active bedscarps. Encouraging meander development in this reach that is relatively barren of instream habitat features will help the overall quality of salmonid habitat.

The channel-spanning rock drop structure proposed for construction in the Cle Elum River will be installed in a sediment transport reach of the system (Geomax 2002). The structure will slightly elevate the water surface in the project reach, but not to a level that will alter river-floodplain interactions over the range of flows observed in the system. As such, no major changes in geomorphic interactions are anticipated other than an overall net gain in spawning substrate captured by the rock drop, and the formation of a scour pool downstream of the center of the structure. Both of these interactions will provide positive habitat attributes for native aquatic species assemblages.

At the locations of the proposed instream structures, the Yakima and Cle Elum Rivers are relatively confined, and although channel-floodplain interactions are limited, channel sediment transport dynamics are still occurring. In the Yakima River, the channel is adjusting to activities undertaken first during railroad construction, and most recently during the construction of the Interstate 90 corridor. Because the Yakima River channel was shortened, realigned, relocated, and placed within a levee, it is attempting to create a meander planform within the constraints the levees provide. This geomorphic process is expected to continue over time, until a new equilibrium channel position is attained. The driving factor in this process is found in the form of competent discharge events that will mobilize bed sediments (cobbles and gravels). In the Action Area, these competent discharges usually coincide with spring runoff, or short duration, high magnitude flow events (rain-on-snow or rain-on-melting snow).

The installation of three rock barbs in the Yakima River and a rock drop structure in the Cle Elum River is intended to promote natural physical processes. Adverse biological effects will be minimal in extent. At the time of the year when bed mobility is highest (high magnitude flow events), MCR steelhead will seek refuge in areas where velocities and sediment movement are not hazardous or, depending on life stage, they will be either migrating into or outmigrating the system. The slackwater habitat and pools created by the construction of these barbs and the rock drop will provide refugia for MCR steelhead during times of elevated discharge. In addition, since the Yakima River barbs will encourage the river to occupy more of its available channel area, the channel between the levees will assume a more natural condition, and MCR steelhead can rely on refuge mechanisms under which they naturally evolved. As a matter of the environmental baseline, especially with respect to the Yakima River reach of the Action Area, construction elements of the action under consultation may serve to improve the Channel Condition and Dynamics pathway (Width/Depth Ratio indicator) of the MPI.

2.1.3.2 Indirect Effects

Indirect effects are caused by the proposed action, are later in time, and are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside of the area directly affected by the action. Indirect effects may include the effects of other Federal actions that have not undergone Section 7 consultation, but will result from the action under consultation. These actions must be reasonably certain to occur, or be a logical extension of the proposed action. The indirect effects resulting from the proposed CCE and TSCE water project include (1) deposition of sediment upstream of the rock drop and downstream from the rock barbs, and formation of a scour pool downstream of the rock drop and at the toe of each rock barb, (2) alteration of the channel morphology, and (3) alteration of riparian vegetation in the project vicinity and downstream reach.

<u>2.1.3.2.1 Sediment Deposition and Scour Pools</u>

After the rock structures are installed, sediments will begin accumulating on the upstream side of the rock drop, and the downstream sides of each rock barb. Those sediments settling out behind the Yakima River rock barbs will cover the previously scoured levee footing and help to eliminate future erosion. Sediments accumulating on the upstream face of the Cle Elum River drop structure could provide spawning substrate for native fish assemblages in a reach that is relatively devoid of such suitable material. The recruitment of sediments into areas that have been subjected to unnatural scour conditions (*i.e.,* Cle Elum River between the road prisms of Bullfrog and Old Bullfrog roads; Yakima River between WSDOT levees) is viewed as a beneficial effect, however, there will also be some cost in terms of habitat loss. The area accumulating sediments includes habitats that are used by salmonids and potentially MCR steelhead. To minimize the loss of habitat, the project proponents have designed a boat notch that will create a similar pool downstream of the rock drop. Additionally, scour pools will form, over time, at the toe of each rock barb. The overall indirect effect of these new pools is expected to be a net improvement in baseline conditions (pool quality) through improved habitat complexity (see below).

2.1.3.2.2 Alteration of Channel Morphology

The construction of the rock drop will have several effects on the existing channel morphology of the Cle Elum River. First, the rock drop will incorporate vertical heterogeneity into the horizontal profile of the river. The drop will act as a step, creating an elevation cline between the water surface upstream and downstream of it. As water encounters the rock drop, it will decelerate, depositing sediments, and then increase velocity again while passing over the structure and downstream. At the boat notch, the elevation gradient between upstream and downstream waters will be minimized and a greater volume of water (per area of the rock drop) will pass through. This will create scour conditions and pool formation immediately downstream. The boat notches will also prevent the rock drop form becoming a potential barrier to passage.

The leveed reach of the Yakima River in the Action Area has produced hydraulic conditions that have encouraged the river to downcut and reside along the toe of the levee. High flows have created local turbulence amongst the large basalt boulders of the levee, and created a long scour pool along its toe via a bedscarp that is presently migrating upstream. These conditions are the usual response to extensive riprap application in conjunction with levee construction (Simons and Richardson 1966; Heede 1986). As such, the baseflow thalweg of the Yakima River is concentrated along the foundation of the levee, pulling the main portion of the channel to the left side of the reach. This characteristic is deleterious to the Yakima River stream channel and its inhabitants (including MCR steelhead), and could endanger other elements of the action under consultation, and structures constructed under previous consultations (refer to WSB-00-480).

Installing three rock barbs along the left bank levee will serve to turn the thalweg of the Yakima River away from this revetment, and will promote more natural processes by spreading discharge (requiring smaller amounts than under the present baseline) across the channel. The scour pool along the base of the levee will be replaced by scour pools at the toe of each barb. Construction of each barb will include LWD addition, and revegetation efforts will encourage the establishment of native riparian species. Overall, sediment transport dynamics will benefit, and greater habitat complexity for native aquatic species assemblages will result. Additionally, the channel of the Yakima River will better process elements vital to the overall aquatic foodweb (Stanford and Ward 1993).

The overall effect of the altered channel morphology will be beneficial to listed MCR steelhead. In the Cle Elum River, increasing the vertical heterogeneity of the channel by adding a rock drop will be an improvement over the existing environmental baseline. As described earlier, the reach of the Yakima River is channelized and is extensively armored because of channel-bracketing WSDOT levees. The proposed rock barbs will increase the functional value of the reach by adding some vertical and lateral diversity to an otherwise homogenous channel, providing slackwater resting areas for adults and juvenile salmonids, and providing areas where sediment accretion will help foster the growth of riparian plants. This, in turn, will serve as an improvement over the existing environmental baseline.

Each of the rock structures in the Cle Elum and Yakima Rivers will incorporate LWD, and will serve to slightly improve the Habitat Elements (LWD indicator) pathway of the MPI over the baseline condition. With respect to barb placement in the Yakima River, the proposed project will improve the Channel Condition and Dynamics (Width/Depth Ration indicator) and Habitat Elements (Pool Quality indicator) pathways of the MPI. The Cle Elum River rock drop will have no effect on the Channel Condition and Dynamics pathway (Width/Depth Ratio indicator), but will slightly improve the Habitat Elements pathway (LWD and Pool Quality indicators) of the MPI as compared to the baseline condition.

2.1.3.2.3 Alteration of Riparian Vegetation

Healthy riparian vegetation serves many important roles in the ecological health of a river. Some of these roles include the production of LWD, stabilizing riverbanks, interacting with and contributing to aquatic foodwebs, and reducing instream temperatures through shading (Gregory *et al.* 1991).

Presently, the Yakima River reach of the Action Area is bracketed by levees consisting of large, angular basalt, and is virtually devoid of riparian vegetation. After construction of the new water intake and rock barbs, native riparian vegetation (primarily willows and black cottonwood) will be planted along the right bank of the river and in the vicinity of each barb. In comparison to the environmental baseline for this reach of the Action Area, the proposed project will improve the Watershed Conditions pathway (Riparian Reserves indicator) of the MPI.

Construction activities at the Cle Elum intake site will permanently remove at least 15 mature black cottonwood trees, and a small amount of herbaceous and early-seral woody vegetation. All trees in the vicinity of the construction site will be marked prior to destruction, and losses will be recorded by species for future mitigation efforts (Entrix 2002). To minimize the effects of this loss, planting will be conducted at a ratio of 6:1 for each species lost. Replanting will occur at the new intake construction site as well as upstream at the old CCE intake site at RM 7.0, as described in Section 1.3.2.1. A monitoring plan will help ensure the survival of these plantings. Over time, if riparian plantings are successful, the proposed action may serve to improve the Watershed Conditions pathway (Riparian Reserves indicator) of the MPI as compared to the environmental baseline.

2.1.3.3 Population Level Factors

Under the environmental baseline, life history diversity has been limited by the influence of hatchery fish, by physical barriers that prevent migration to historical spawning or rearing areas, and by water temperature barriers that influence the timing of emergence, juvenile growth rates, or the timing of upstream or downstream migration. The CCE and TSCE water project is expected to add temporary, construction related detrimental effects to the existing environmental baseline. Conversely, certain aspects of the CCE and TSCE water project will benefit fisheries habitat as compared to the baseline condition over the long term (*e.g.*, riparian plantings and rock barbs in the denuded Yakima River reach). However, these effects, detailed above, are not expected to have any significance at the population level. Therefore, NMFS believes that the proposed action does not contain measures that are likely to adversely affect the population trends, habitat and hydrology, life-history diversity, or the influence of hatcheries on the ESU compared to conditions under the environmental baseline.

2.1.3.4 Effects on Critical Habitat

NMFS designates Critical Habitat for a listed species based upon physical and biological features that are essential to that species. Essential features of Critical Habitat for the MCR steelhead ESU include substrate, water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (65 Fed. Reg. 7764; February 16, 2000).

The direct and indirect effects previously discussed include effects on Critical Habitat to a limited extent. Elements of critical habitat that are likely to be affected are expressed in the MPI as the Flow/Hydrology, Water Quality, Habitat Elements, Channel Condition and Dynamics, and Watershed Conditions pathways. Within these pathways, and when considering the action under consultation in comparison to the environmental baseline, the functional quality of most indicators will be maintained. The exceptions are the temporary effects of turbidity/sediment which will briefly degrade indicators in the Water Quality pathway (Sediment/Turbidity indicators), an improvement in the Habitat Elements pathway (LWD and Pool Quality indicators), and a possible improvement in the Channel Conditions and Dynamics pathway (Width/Depth Ratio indicator). Relating these indicators back to essential habitat elements, under the assumption that USDA-RD affects all water quality, revegetation, and rehabilitation procedures, the primary effect of this action will be a short-term decline in water quality and substrate conditions.

The long-term effects of the project are likely to benefit listed MCR steelhead critical habitat. NMFS believes that the loss of the existing scour pool and riparian habitat along the levee reach in the Yakima River after construction of this project will be outweighed by the benefits of increased instream habitat heterogeneity, new scour pools created downstream of the rock barbs, and by riparian plantings. In addition, the barbs will encourage more natural channel processes, as previously described. The rock drop structure in the Cle Elum reach will provide increased habitat heterogeneity, provide a scour pool below the structure, incorporate LWD into the channel, and capture spawning gravels. These mechanisms will serve to locally improve the Habitat Elements, Channel Condition and Dynamics, and Watershed Conditions pathways of the MPI in the Action Area. Accordingly, the proposed action is unlikely to diminish the value of the affected habitat elements to the survival and recovery of MCR steelhead.

2.1.4 Cumulative Effects

Cumulative Effects are defined in 50 C.F.R. 402.02 as "those effects of future state or private activities, not Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." For this analysis, cumulative effects for the general Action Area are considered. Future Federal actions, including the ongoing operation of hatcheries, irrigation projects, fisheries, and land management activities have been or will be reviewed through separate Section 7 consultation processes.

It is expected that a range of non-Federal activities would occur within the Yakima River Basin for the purposes of restoring and enhancing fish habitat. These activities would likely include installing fish screens, improving flow management and irrigation efficiency, restoring instream and riparian habitat, and removing barriers to passage. Although the specific details of individual projects are lacking, it is assumed that non-Federal conservation efforts would continue or increase in the near future.

In addition to potential beneficial projects, it is also likely that much of the private land management and water regulation will continue under existing conditions. Specific activities such as farming in or adjacent to sensitive riparian areas, allowing livestock to access Critical Habitat, and tributary diversions that (1) remove large volumes of water and (2) block access to quality habitats will continue to adversely affect listed MCR steelhead.

2.1.5 Conclusion/Opinion

NMFS jeopardy analysis is based upon the present status of the species, the environmental baseline for the Action Area, and the effects of the proposed action. The analysis takes into account the species' status because determining the effect upon a species' status is the essence of the jeopardy determination. Depending upon the specific considerations of the analysis, actions that are found likely to impair presently properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale will generally be determined likely to jeopardize the continued existence of listed salmon, adversely modify their critical habitat, or both. Specific considerations include whether habitat condition was an important factor for decline in the listing decision, changes in population or habitat conditions since listing, and any new information that has become available (NMFS 1999).

NMFS has determined that the effects of the proposed action will not jeopardize the continued existence of MCR steelhead or result in the adverse modification or destruction of critical habitat. The instream construction elements of the CCE and TSCE water project will create short term direct effects with a more than negligible chance of causing incidental take. The most significant risks are posed by (1) the temporary increase in turbidity that will occur during instream excavation and rock placement, (2) mechanical injury to MCR steelhead attendant to instream construction and excavation, and (3) the entrapment of MCR steelhead behind coffer dams as the water intake work sites are isolated from the active channel. The risk of take will be minimized by the implementation of conservation measures, WDFW Hydraulic Permit Application provisions, and construction timing restrictions as set forth in this BO. At no time, and without contingencies, will the activities described in this BO have levels of take or destroy habitat that would appreciably reduce the likelihood of survival and recovery of MCR steelhead.

2.1.6 Reinitiation of Consultation

Consultation must be reinitiated if (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; or (3) a new species is listed or Critical Habitat is designated that may be affected by the action (50 C.F.R. 402.16). NMFS will be monitoring the listed reasonable and prudent measures and terms and conditions of the incidental take statement. NMFS may reinitiate consultation if the above measures are not adequately completed, resulting in increased probability of take to listed species. To reinitiate consultation, the USDA-RD must contact the Habitat Conservation Division (Washington Habitat Branch Office) of NMFS.

2.2 Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to Section 4 (d) of the Act prohibit the take of endangered and threatened species without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined as significant habitat modification or degradation that results in death or injury to listed species by "significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering" (50 C.F.R. 222.102). Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and is not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary; in order for the exemption in Section 7(o)(2) to apply, they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant as appropriate. The USDA-RD has a continuing duty to regulate the activity covered in this incidental take statement. If the USDA-RD fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

An incidental take statement specifies the effect of any incidental taking of endangered or threatened species. The take statement also provides reasonable and prudent measures that are necessary to minimize effects and sets forth terms and conditions with which the action agency must comply to implement the reasonable and prudent measures.

2.2.1 Amount or Extent of Take Anticipated

As stated in Section 2.1.1, above, listed steelhead use the upper Yakima and Cle Elum Rivers for both spawning and rearing. Based on information reported in Phelps *et al*. (2000), Hockersmith *et al.* (1995), and Busack *et al.* (1991), MCR steelhead are likely in the Action Area every day of the year. Therefore, incidental take of MCR steelhead is reasonably certain to occur. Despite the use of the best scientific and commercial data available, NMFS cannot estimate a specific amount of incidental take of individual fish. However, NMFS believes that there are several mechanisms through which take of MCR steelhead may occur, and that the extent of take can be described in relation to the extent to which project activities alter baseline conditions, after the use of best management practices. For this proposed action, harm could result in three main ways. Direct harm or injury may result from near-water and in-water construction activities via mechanical injury and/or turbidity primarily from excavation and rock work. Additionally, the entrapment of MCR steelhead behind coffer dams as the water intake work sites are isolated from the active channel would result in take.

The extent to which these mechanisms can result in effects on listed steelhead or their habitat can be described qualitatively, enabling reinitiation of consultation if such effects are exceeded during the project: (1) turbidity increases will not extend further downstream than Yakima RM 181.0, (2) intake construction will only occur behind cofferdams in an isolated environment after fish have been removed from the area by herding and beach seining by a qualified fishery scientist, and (3) riverbed disturbances will not continue outside of the defined work windows (October 1 to December 31, 2002 for Yakima River activities; October 1 to November 15 thereafter). NMFS does not expect any additional take through the indirect effects of the proposed activities.

2.2.2 Reasonable and Prudent Measures

NMFS believes that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimizing take of MCR steelhead. These RPMs are integrated into the BA and proposed project, and NMFS has included them here to provide further detail as to their implementation.

1. The USDA-RD will minimize take by incorporating BMPs to reduce potential effects of staging and onshore construction activities.

2. The USDA-RD will minimize take by incorporating BMPs to reduce potential effects of instream construction activities.

3. The USDA-RD will minimize take by safely removing fish from work areas that will be isolated from adjacent river channels by coffer dams.

4. The USDA-RD will minimize take by ensuring development of functional riparian habitat.

5. The USDA-RD will minimize take by completing NMFS Hydropower Program Review of pump intake screens.

6. The USDA-RD will minimize take by incorporating appropriate timing restrictions.

2.2.3 Terms and Conditions

To comply with ESA Section 7 and be exempt from the prohibitions of Section 9 of the ESA, the USDA-RD must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Implement RPM #1 by conducting the following:

    1.1 A temporary erosion and sediment control (TESC) plan will be implemented.

    1.2 A spill prevention, control, and containment (SPCC) plan will be implemented.

    1.3 Hydraulic fluid in heavy equipment will be replaced with mineral oil or other biodegradable, non-toxic hydraulic fluid.

    1.4 All heavy equipment will be clean and free of external oil, fuel, or other potential pollutants.

2. Implement RPM #2 by conducting the following:

    2.1 During construction of the rock barbs, heavy equipment will work from on-shore (or constructed) staging areas, with the exception of the actual excavator arm and bucket.

    2.2 Prior to instream construction of the rock drop, any large equipment intended for instream use will be steam cleaned.

    2.3 During construction of the rock drop, work will progress from the banks of the river towards the center, the excavator will travel on rocks previously placed, and the excavator will be steam-cleaned prior to instream work.

    2.4 Placement of rocks and/or water intake structural components will be done by a qualified excavator operator.

    2.5 Any fill material entering the Cle Elum or Yakima Rivers will be clean, free of fines, and will consist of native rock.

2.6 Instream aspects of closure of the old CCE water intake at Cle Elum RM 7.0 will be accomplished by hand, all valves and gates will be welded shut, and the pipeline behind the intake structure will be blocked to prevent leakage.

3. Implement RPM #3 by conducting the following:

3.1 Prior to coffer dam closure, fish will be removed from the area by herding and beach seining by a qualified fishery scientist.

3.2 Each coffer dam will be adequately constructed to totally the work area from adjacent river channels.

3.3 In the event that listed steelhead are killed or injured during the herding and netting process, the qualified fishery scientist will immediately contact NMFS.

4. Implement RPM #4 by conducting the following:

4.1 At the Cle Elum intake site, destroyed riparian vegetation will be counted and recorded as to species composition.

4.2 Riparian plantings at ratio of 6:1 for each species lost will take place at the new Cle Elum River intake construction site as well as upstream at the old CCE intake site at Cle Elum RM 7.0.

4.3 Additional riparian plantings will occur at each barb, and along both banks of the Yakima River in the vicinity of the proposed water intake site.

4.4 All plantings will use native species appropriate for riparian use and will be planted by hand tools or non-invasive mechanical methods.

4.5 All plantings will be monitored for at least five years to ensure 80% survival; replanting will occur if survival rates are less than 80%.

4.6 Each year for five years, a monitoring report detailing planting locations, methods, composition, and survival will be submitted to:

NMFS-WHB
Ellensburg Field Office
Attn: Kale Gullett
304 South Water St., Ste. 201
Ellensburg, WA 98926

5. Implement RPM #5 by conducting the following:

5.1 The USDA-RD will complete the screen review process (presently underway) with the Hydropower Division of NMFS to ensure compliance with NMFS Screening Criteria.

5.2 After NMFS Hydropower Division screen criteria review is complete, the USDA-RD will send any pertinent administrative documents generated during the screen review process to the person and address listed in Term and Condition 2.2.3.4.6, above.

6. Implement RPM #6 by conducting the following:

6.1 If funding and permit requirements are in place, work in the Yakima River reach of the Action Area will commence on October 1, 2002 and be completed by December 31, 2002, unless high discharge events preclude in-water work.

6.2 Work in the Cle Elum River, regardless of the year in which it is undertaken, will occur between October 1^{st} and November 15th,

2.2.4 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or Critical Habitat, to help implement recovery plans, or to develop additional information.

To encourage greater habitat diversity near the project area, NMFS recommends increasing riparian planting in the upstream and downstream vicinity of the project, and placing LWD along the riverbanks. Placing LWD may encourage higher densities of juvenile MCR steelhead (Peters *et al.* 1998). Presently, the reaches of the Yakima and Cle Elum rivers in the Action Area lack the habitat heterogeneity essential for reaching PFC.

NMFS must be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitat. Accordingly, NMFS requests notification of the implementation of any conservation recommendations.

3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));

- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH (§305(b)(4)(A));

- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the effect of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 C.F.R. 600.110). Adverse effect means any effect which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g*., loss of prey or reduction in species fecundity), site-specific or habitat-wide effects, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810).

Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies regarding any activity that may adversely affect EFH, regardless of its location.

The objective of this Essential Fish Habitat (EFH) consultation is to determine whether the proposed action may adversely affect designated EFH, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

3.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for Federally-managed fisheries within the waters of Washington, Oregon, and California. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies presently, or historically accessible to salmon in Washington, Oregon, Idaho, and

California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years) (PFMC 1999). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the effects to these species' EFH from the proposed action is based, in part, on this information.

3.3 Proposed Actions

The proposed action and Action Areas are detailed above in Sections 1.3 and 1.4 of this BO. The Action Area contains habitats that have been designated as EFH for various life-history stages of chinook and coho salmon.

3.4 Effects of Proposed Actions

As described in detail in Section 2.1.3 of this BO, the proposed activities may result in detrimental short and long-term effects to a variety of habitat parameters. These adverse effects are:

3.4.1 Short term degradation of water quality (turbidity) because of instream and near-stream construction activities.

3.4.2 Short term degradation of benthic foraging habitat because of instream rock placement.

3.4.3 Short term degradation of habitat because riparian trees and vegetation will be removed.

3.5 Conclusion

NMFS believes that the proposed action may adversely affect designated EFH for chinook and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions that would adversely affect EFH. Because the conservation measures that the USDA-RD included as part of the proposed actions to address ESA concerns are also adequate to avoid, minimize, or otherwise offset potential adverse effects to chinook salmon to the maximum extent practicable, conservation recommendations are not necessary.

3.7 Statutory Response Requirement

Since NMFS is not providing conservation recommendations at this time, no 30-day response from the USDA-RD is required (MSA §305(b)(4)(B)).

3.8 Supplemental Consultation

The USDA-RD must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R. 600.920(k)).

4.0 REFERENCES

Alabyan, A.M., and R.S. Chalov. 1998. Types of river channel patterns and their natural controls. Earth Surface Processes and Landforms 23: 467-474.

Allan, J.D. 1995. Stream Ecology: structure and function of running waters. Chapman and Hall, Inc., New York.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Can. J. Fish. Aquat. Sci. 42: 1410-1417.

Bishop, S., and A. Morgan, (eds.). 1996. Critical habitat issues by basin for natural chinook salmon stocks in the coastal and Puget Sound areas of Washington State. Northwest Indian Fisheries Commission, Olympia, WA, 105 pp.

Bisson, P. A., and R. E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. N. Am. J. Fish. Manage. 4: 371-374.

Bottom, D. L., P. J. Howell, and J. D. Rodgers. 1985. The effects of stream alterations on salmon and trout habitat in Oregon. Oregon Department of Fish and Wildlife, Portland.

Busack, C., C. Knudsen, A. Marshall, S. Phelps and D. Seiler. 1991. Yakima Hatchery Experimental Design. Annual Progress Report DOE/BP-00102, Bonneville Power Administration, Div. of Fish and Wildlife, Portland, Oregon. 226 pp.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. NOAA Tech. Memo. NMFS-NWFSC-27, 261 p.

Busby, P., and 10 co-authors. 1999. Updated status of the review of the Upper Willamette River and Middle Columbia River ESUs of steelhead *(Oncorhynchus mykis*s). National Marine Fisheries Service, Northwest Fisheries Science Center, West Coast Biological Review Team, Seattle, Washington.

Campton, D. E., and J. M. Johnston. 1985. Electrophoretic evidence for a genetic admixture of native and nonnative rainbow trout in the Yakima River, Washington. Trans. Am. Fish. Soc. 114: 782-793.

Chapman, D., C. Pevan, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants, Inc., Boise, Idaho.

Dunne, T., and Leopold, L.B. 1978. Water in Environmental Planning: Freeman, San Francisco, 818 p.

Dykarr, B.D. and P.J. Wigington, Jr.. 2000. Floodplain formation and cottonwood colonization patterns on the Willamette River, Oregon, U.S.A. Environmental Management 25: 87-104.

Entrix, Inc. (Entrix). 2002. Biological Assessment Addendum No. 2: Water intake structure modifications on the Cle Elum and Yakima Rivers. Prepared for the City of Cle Elum, WA , by Entrix, Inc., Olympia WA. 20pp., plus attachments.

Fast, D., J. Hubble, M. Kohn and B. Watson. 1991. Yakima River spring chinook enhancement study: final report. Bonneville Power Administration, Div. of Fish and Wildlife, Portland, Oregon, DOE/BP-39461-9. 345 pp.

Fausch, K.D., C. Gowan, A.D. Richmond, and S.C. Riley. 1994. The role of dispersal in trout population response to habitat formed by large woody debris in Colorado mountain streams. Bulletin Français de la Pêche et de la Pisciculture 337/338/339:179-190.

Geomax Professional Engineers (Geomax). 2002. Yakima/Cle Elum River study: Final report. Prepared for the City of Cle Elum, WA by Geomax Professional Engineers, Spokane, WA. 35pp., plus appendices.

Gregory, S. V., F. J. Swanson, W. A. McKee, and K. W. Cummins. 1991. An ecosystem perspective of riparian zones. Bioscience 41: 540-551.

Gregory, R. S., and T. S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile chinook salmon (*Oncorhynchus tshawytscha*) in turbid laboratory conditions. Can. J. Fish. Aquat. Sci. 50: 223-240.

Heede, B.H. 1986. Designing for dynamic equilibrium in streams. Water Resources Bulletin 22(3): 351-357.

Hilborn, R. 1992. Can fisheries agencies learn from experience? Fisheries 17: 6-14.

Hockersmith, E., J. Vella, and L. Stuehrenberg. 1995. Yakima River radio-telemetry study: steelhead, 1989-1993. Annual report submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-00276-3.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Knedra, and D. Orrmann. 1985. Stock assessment of Columbia River anadromous salmonids, 2 volumes. Final Report to Bonneville Power Administration, Portland, Oregon (Project 83-335).

Huibregtse, Louman and Associates, Incorporated (HLA). 2001. City of Cle Elum and town of South Cle Elum water system improvements: NEPA environmental report. Produced by HLA, with Shapiro and Associates, Inc., and Vicki Morris Consulting Services, Yakima, WA. 116 pp. Plus appendices.

Hynes, H.B.N. 1983. Groundwater and stream ecology. Hydrobiologia 100: 93-99.

Kinnison, H. B. and J. E. Sceva. 1963. Effects of Hydraulic and Geologic Factors on Streamflow of the Yakima River Basin Washington. U.S. Geological Survey Water Supply Paper 1595. U.S. Government Printing Office, Washington, D.C. 135 pp.

Leopold, L.B., M.G. Wolman and J.P. Miller. 1964. Fluvial processes in geomorphology. W.H. Freeman and Company, San Francisco, CA.

Lichatowich, J. A. and L. E. Mobrand. 1995. Analysis of Chinook salmon in the Columbia River from an ecosystem perspective. U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon. 102 pp.

Lichatowich, J. A., L. Mobrand, L. Lestelle and T. Vogel. 1995. An approach to the diagnosis and treatment of depleted Pacific salmon populations in Pacific Northwest watersheds. Fisheries 20: 10-18.

Lilga, M.C. 1998. Effects of flow variation on stream temperatures in the lower Yakima river. Masters Thesis, Washington State University, Pullman, Washington. 91 pp.

Mackay, R.J. 1992. Colonization by lotic macroinvertebrates: a review of processes and patterns. Can. J. Aquat. Sci. 49: 617-628.

McClure, M.M., E.E. Holmes, B.L. Sanderson, and C.E. Jordan, in review (2001). A standardized quantitative assessment of status in the Columbia River Basin. Ecological Applications.

Minshall, G. W., R. C. Petersen, K. W. Cummins, T. L. Bott, J. R. Sedell, C. E. Cushing and R.L. Vannote. 1983. Interbiome comparison of stream ecosystem dynamics. Ecological Monographs 51: 1-25.

Minshall, G. W., K. W. Cummins, R. C. Petersen, C. E. Cushing, D. A. Bruns, J. R. Sedell, R. L. Vannote. 1985. Developments in stream ecosystem theory. Can. J. Fish. Aquat. Sci. 42: 1045-1055.

National Marine Fisheries Service (NMFS). 1996. Factors for decline: a supplement to the notice of determination for West Coast steelhead under the Endangered Species Act. National Marine Fisheries Service, Protected Resources Branch, Portland, Oregon.

National Marine Fisheries Service (NMFS). 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. NOAA Tech. Memo NMFS-NWFSC-35. 443 pp.

National Marine Fisheries Service (NMFS). 2000. Biological Opinion on Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the

Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. Northwest Region, Portland, OR.

National Research Council Committee on Protection and Management of Pacific Northwest Anadromous Salmonids (NRCC). 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press, Washington, DC, 452 pp.

Nehlsen, W., J.E. Williams and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho and Washington. Fisheries 16: 4-21.

Newcombe, C.P., and Jensen, J.O.T. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. N. Am. J. Fish. Manag. 16: 693–727.

Omernik, J. M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers 77: 118-125.

Pacific Fishery Management Council (PFMC). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

Pentec Environmental (Pentec). 2000. Biological Assessment: Water intake structure modifications on the Cle Elum and Yakima Rivers. Prepared for Huibregtse, Louman Associates, Inc., and the City of Cle Elum, WA, by Pentec Environmental, Edmonds, WA. 48pp., plus figures and appendices.

Pearsons, T. N., G. A. McMichael, S. W. Martin, E. L. Bartrand, J. A. Long and S. A. Leider. 1996. Yakima species interactions studies. Annual Report FY 1994. Bonneville Power Administration DOE/BP-99852-3.

Peters R.J., B.R. Missildine, and D.L. Dow. 1998. Seasonal fish densities near river banks stabilized with various stabilization methods. First year report of the Flood Technical assistance Project. U.S. Fish and Wildlife Service, North Pacific Coast Ecoregion, Western Washington Office, Aquatic Resources Division. Lacey, WA.

Phelps, S.R., B.M. Baker and C.A. Busack. 2000. Genetic relationships and stock structure of Yakima River basin and Klickitat River basin steelhead populations. Washington Department of Fish and Wildlife Genetics Unit unpublished report. Olympia, Washington. 56 pp.

Ralph, S.C., G.C. Poole, L.L. Conquest, and R.J. Naiman. 1994. Stream channel morphology and woody debris in logged and unlogged basins of western Washington. Canadian Journal of Fisheries and Aquatic Sciences 51: 37-51.

Reisenbichler, R. R., J. D. McIntyre, M. F. Solazzi, and S. W. Landino. 1992. Genetic variation in steelhead of Oregon and northern California. Transactions of the American Fisheries Society 121:158-162.

Schreck, C. B. H. W. Li, R. C. Jhort, and C. S. Sharpe. 1986. Stock identification of Columbia River chinook salmon and steelhead trout. Final report to Bonneville Power Administration, Portland, Oregon (Project 83-451).

Sedell, J. R., G. H. Reeves, F. R. Hauer, J. A. Stanford, and C. P. Hawkins. 1990. Role of refugia in recovery from disturbances: Modern fragmented and disconnected river systems. Environmental Management 14: 711-724.

Servizi, J. A., and D. W. Martens. 1987. Some effects of suspended Fraser River sediments on sockeye salmon (*Oncorhynchus nerka*), p. 254-264. *In* H. D. Smith, L. Margolis, and C. C. Wood eds. Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Can. Spec. Publ. Fish. Aquat. Sci. 96.

Shaw, E.A. and J.S. Richardson. 2001. Direct and indirect effects of sediment pulse duration on stream invertebrate assemblages and rainbow trout (*Oncorhynchus mykiss*) growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58:2213-2221.

Sigler, J. W., T.C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelheads and coho salmon. Trans. Am. Fish. Soc. 113: 142-150.

Simons, D.B. and E.V. Richardson. 1966. Resistance to flow in alluvial channels. U.S. Geological Survey Professional Paper 422-J. USGS, Reston, VA.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon.

Stanford, J.A. and J.V. Ward. 1988. The hyporheic habitat of river ecosystems. Nature 335(6185): 64-66.

Stanford, J. A., and F. R. Hauer. 1992. Mitigating the impacts of stream and lake regulation in the Flathead River catchment, Montana, U.S.A.: an ecosystem perspective. Aquatic Conservation: marine and freshwater ecosystems 2: 35-63.

Stanford, J. A. and J. V. Ward. 1993. An ecosystem perspective of alluvial rivers: connectivity and the hyporheic corridor. J. N. Am. Benthol. Soc. 12(1): 48-60.

Stanford, J. A., J. V. Ward, W. J. Liss, C. A. Frissell, R. N. Williams, J. A. Lichatowich and C.C. Coutant. 1996. A general protocol for restoration of regulated rivers. Regulated Rivers 12: 391-413.

Stanford, J. A. and T. Gonser. 1998. Special Issue. Rivers in the Landscape: Riparian and groundwater ecology. Freshwater Biology 40(3): 401-585.

Tuck, R. L. 1995. Impacts of irrigation development on anadromous fish in the Yakima River Basin, Washington. Masters Thesis, Central Washington University, Ellensburg, Washington. 246 pp.

Vaccaro, J.J. 1986. Simulation of streamflow temperatures in the Yakima river basin, Washington, April-October 1981. U.S. Geological Survey Water Resources Investigations Report 85-4232, Tacoma, Washington.

Vannotte, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell and C. E. Cushing. 1980. The river continuum concept. Can. J. Fish. Aquat. Sci. 37: 130-137.

Wallace, J. B., J. R. Webster and T. F. Cuffney. 1982. Stream detritus dynamics: regulation by invertebrate consumers. Oecologia 53:197-200.

Waples, R. S. 1991. Pacific salmon, *Oncorhynchus* spp., and the definition of "species" under the Endangered Species Act. Mar. Fish. Rev. 53: 11-22.

Ward, J. V. and J. A. Stanford. 1995a. The serial discontinuity concept: extending the model to floodplain rivers. Regulated Rivers 10: 159-168.

Ward, J. V. and J. A. Stanford. 1995b. Ecological connectivity in alluvial river ecosystems and its disruption by flow regulation. Regulated Rivers 11(1): 105-119.

Washington Department of Fisheries and Washington Department of Wildlife (WDF). 1993. Washington State Salmon and Steelhead Stock Inventory. Appendix Three; Columbia River Stocks. Washington Department of Fisheries, Olympia, Washington.

Waters, T.F. 1995. Sediment in streams: Sources, biological effects and controls. American Fisheries Society Monograph 7, Bethesda, Maryland.

Yakima Subbasin Summary (YSS). 2001. Prepared for the Northwest Power Planning Council, Portland, OR. Laura Berg, Editor. 376 pp.

Young, M.K., D. Haire and M. Bozek. 1994. The effect and extent of railroad tie drives in streams of southeastern Wyoming. Western Journal of Applied Forestry 9(4):125-130.